

WHAT IS CLAIMED IS:

1. An ultrasonic cleaning apparatus in which ultrasonic vibration is applied to at least part of cleaning solution, and, by a piece-by-piece method, a material to be cleaned is cleaned with the cleaning solution while being carried in a predetermined direction, the ultrasonic cleaning apparatus comprising:

a plurality of ultrasonic vibration units each having a nozzle elongated in one direction, for spraying cleaning solution from the nozzle to the material to be cleaned, the cleaning solution being applied with ultrasonic vibration by a vibration plate to which a vibrator is fixed so as to pair up therewith,

wherein the plural ultrasonic vibration units are arranged in two rows in a widthwise direction orthogonal to the carrying direction, and also so arranged that a certain ultrasonic vibration unit of one row is located toward a substantially center of two adjacent ultrasonic vibration units of the other row.

2. The ultrasonic cleaning apparatus of claim 1,

wherein the ultrasonic vibration unit includes:

a holding member for holding the vibrator;

a power supply member for supplying a high frequency power to the vibrator by making elastic contact with an electrode of the vibrator and the holding member;

a wire for supplying the power to the power supply member;

and

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a casing having an enclosed space portion formed therein for accommodating the vibrator, the power supply member, and the wire, and

wherein the nozzle with a predetermined dimensional width is disposed adjacent to the vibration plate, the nozzle including a projection piece for supplying cleaning solution through which ultrasonic vibration is transmitted to the vibration plate and for convectively circulating the cleaning solution.

3. The ultrasonic cleaning apparatus of claim 2, wherein, in each of the ultrasonic vibration units arranged, the casing includes:

a cleaning solution supply path for supplying cleaning solution to the nozzle;

an air supply path for supplying air to the enclosed space portion; and

a wire-laying path for laying down the wire required to supply the power to the vibrator.

4. The ultrasonic cleaning apparatus of claim 3, wherein, in each of the ultrasonic vibration units, the casing is provided with an opening portion for providing communication among the enclosed space portion, the air supply path, and the wire-laying path,

and wherein, by circulating inert gas or dry air, the power

supply member, the wire, and the vibrator are put under inert gas atmosphere or dry air atmosphere.

5. The ultrasonic cleaning apparatus of claim 4,  
wherein the internal pressure of the enclosed space portion is higher than the pressure of the cleaning solution which is supplied to the nozzle and is ejected therefrom.

6. The ultrasonic cleaning apparatus of claim 2,  
wherein, in each of the ultrasonic vibration units, the vibrator and the power supply member are fastened to the casing constituting the enclosed space portion by screws and are thus detached therefrom with ease.

7. The ultrasonic cleaning apparatus of claim 1,  
wherein the ultrasonic vibration in use has a frequency within a range of 400 kHz to 2MHz.

8. The ultrasonic cleaning apparatus of claim 1,  
wherein opening portions of both end nozzles arranged in the widthwise direction are located so that the target material to be cleaned is interposed between the both nozzles, as viewed in the carrying direction.

9. An ultrasonic cleaning method for cleaning both surfaces

of a material to be cleaned, comprising the steps of:

placing the ultrasonic cleaning apparatus of claim 1 toward a side of one surface of a material to be cleaned so that cleaning solution applied with ultrasonic vibration is sprayed to the surface of the material to be cleaned; and

placing a cleaning solution supply nozzle toward a side of other surface of the material to be cleaned so that cleaning solution is sprayed to the other surface.

10. An ultrasonic cleaning method for cleaning a material to be cleaned, comprising the step of:

placing the ultrasonic cleaning apparatus of claim 1 above a to-be-cleaned surface of a material to be cleaned so that cleaning solution applied with an ultrasonic vibration is sprayed to the material to be cleaned.